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GEIKIE'S GEOLOGY.

Text-book of Geology. By Sir Archibald Geikie, F.R.S. 4th Edition, revised and enlarged, 2 vols. Pp. xxi + 702; ix + 705 to 1472. (London: Macmillan and Co., Ltd., 1903.) Price 30s. net.

WHEN Sir Charles Lyell found that, owing to the rapid progress of geology, his early treatise must be extended beyond the limits of one handbook, he divided his subject into two parts. In the "Elements" he described the ancient changes of the earth and its inhabitants, as illustrated by geological monuments, and in the "Principles" he treated of the modern changes of the earth and its inhabitants considered as illustrative of geology. In the Elements we have a selection of facts upon which geologic history is founded; in the Principles we have a statement of the laws which have governed those changes based not only on the records of the past, but also and chiefly upon the observation of what is now going on in the present. Thus the Principles, which include that which we arrive at last, is, as its name implies, that which from an educational point of view we take first.

Sir Archibald Geikie has found that, in keeping his admirable text-book up to date, he has accumulated more material than could be conveniently contained in one volume, and has therefore issued it in two; but these are two volumes of one work, in fact the break takes place in the middle of one of his subdivisions of the subject—not inconveniently, however, as the first volume ends with the description of the aqueous deposits, and the second begins with the igneous rocks, both of which are included under structural geology. When, however, we look into the work, we see that its future is suggested not by its separation into two volumes, but by its subdivision into seven books.

The subject of the first book is the earth's place in the solar system, and the effect of the various cosmical forces acting upon it, in producing or modifying the geological condition of its crust. These have to be taken account of in discussing almost any geological question, whether glacial or volcanic phenomena, climatal conditions, the distribution of life, the age of the earth, or even such a question as the lateral erosion of river valleys, which, as some hold, depends largely upon the same influences as those which control the direction of the trade winds and ocean currents. The Garonne and the Volga, for instance, the one running north, the other running south, cling to their right bank, owing, it is suggested, to the rotation of the earth as they run at an ever increasing or decreasing distance from the axis of rotation. Although we must allow that this influence is a *vera causa*, always acting, and tending to deflect such running waters east or west, still, one cannot but feel that the variations in the level of the river beds, the winding of their courses, and the earth movements, which are known to have taken place in recent times over the areas in question, must have

been far more important factors in regulating the course of the streams.

In the Second Book we learn about the materials of which the earth is composed, the chemical constituents of the crust, their mode of aggregation into what are known as minerals, and the methods of discrimination and classification of the sedimentary and igneous rocks; of rocks in the building up of which living organisms have played a part, and of rocks which have been altered by mechanical, chemical, or thermal agents so much that it is often difficult to recognise what their original character was. In this book we have glossaries of rock-forming minerals, of rocks of different composition and origin, and of various accessory substances, many of which are of economic value.

The author does not propose to treat specially of economic questions, but no one can understand the distribution and methods of obtaining coal, oil, metals, underground waters, and other products of the earth, without such a knowledge of their origin and mode of occurrence as may be gained from this work.

The Third Book deals with earthquakes and volcanoes, and has to do with the causes of upheaval and subsidence, the effects produced by internal heat, hydrothermal action, pressure and the accompanying chemical and mineralogical changes. These are subjects to which our author has paid special attention—"quorum pars magna fui," he might justly say of them—and for this reason as well as from their own intrinsic importance, we welcome his fuller treatment of them. In the second part of the same book he discusses denudation and its correlative deposition, and all the various forces of air, water, and ice, and of living things, by which they were brought about.

The changes which have taken place in the interior of the earth we should, at first sight, have thought to be one of the last subjects to which experimental research could have been applied; yet we learn that towards the end of the eighteenth century De Saussure set himself to study the possible derivation of rocks, by fusing samples of them, and judging whether, as had been alleged, some had arisen from the melting of others; but Sir James Hall more fully realised how far the processes of nature might be imitated by man, and about a hundred years ago described a series of ingenious experiments, by which he demonstrated the possibility of producing either a vitreous or a stony condition in fused rocks, according to the rate at which they are allowed to cool. Daubrée followed up this kind of experimental geology, and showed not only that various minerals usually found associated with volcanic and metamorphic rocks could be developed in the laboratory in their proper crystalline form, but also that enclosures and structures, analogous to those found in ancient schistose, and altered rocks could be artificially produced.

In Book IV. our author follows up his explanations of the *modus operandi* with an account of the results produced. He now describes the arrangement of the materials of the earth's crust, first of all considering the sedimentary rocks, their bedding and joints, their dip and strike, their cleavage and faults; also the pro-

trusion of solid masses and other phenomena connected with stratigraphical structure.

Here we have only just arrived at the end of the first volume of the present issue. The second volume begins in the middle of Book IV., with a continuation of the description of the manner in which the earth's crust has been built up and modified. This second part, however, refers to the action of internal heat and pressure, that is to say, it deals with rocks of igneous origin, whether superficial or deep-seated, and this leads to the consideration of earth movements, without which we should be unable to examine such rocks at all. Incidentally he here describes the mode of formation of veins and lodes.

Book V. gives a series of very much condensed, but still very useful notes on fossils and their place and use in geological investigations. This might be greatly extended.

Then follows in Book vi. the whole of systematic stratigraphy.

Our author arranges the stratified rocks under fifteen heads, and treats of their general characters, their flora and fauna, and their local development at home and abroad; but this, again, our author could easily develop into at least five volumes, representing the five groups under which the whole of historical geology could be very conveniently arranged.

In the seventh and last book he deals with the geographical features of the earth's surface, as affected by its geological character, and the arrangement of the materials of which it is composed.

There are buried in this text-book an immense number of facts vastly interesting to the general reader, and especially to the traveller who goes about with his eyes open, but without knowledge to follow the processes by which nature brings about the wonderful results observed. For instance, how seldom he realises when he sees the great blocks of travertine, so commonly used for building in Rome, that this *lapis Tiburtinus*, modified by Italian lips into travertino, is not a rock built up by the same kind of sediment as that of which most of the building stones he has seen elsewhere are composed, but that it is carbonate of lime which has been thrown down from chemical solution, and that plants have helped to collect it, while another similar rock, as commonly used elsewhere, has been collected by small animals, particle by particle, out of the sea water in which it was dissolved. Or if he is looking at those marvellous relics of volcanic activity, the geysers, which heap up silica instead of carbonate of lime, he will find that there also a small confervoid alga helps to collect the pasty material which afterwards hardens into flint. These are examples of scientific facts which would not force themselves upon the observation of the ordinary tourist, but which it would greatly add to his enjoyment of travel to know. Or, to take another more abstruse example, the study of the earth's satellite has suggested that the scars and pits upon it are due to the impact of aggregations of matter, and a similar bold hypothesis has been offered in explanation of certain depressions upon the earth. A basin-like hollow among the sandy mounds of

Arizona was caused, it was suggested, by the impact of a meteoric body now possibly buried out of sight below, while the basin of the Atlantic, according to others, marks the area from which the material of the moon broke away from its moorings and commenced its long spiral spin round the earth. Such flights of imagination have often given us working hypotheses, which after pruning and shaping have found a place among the explanations of the order of the world. While we welcome all such tentative interpretations of phenomena, we must carefully weigh the evidence adduced, and not too hastily say proven or not proven.

The work is encyclopædic in character and arrangement, and, but that, alas! the question of cost has to be taken into consideration, we should gladly welcome its appearance in a dozen or more goodly volumes, the contents of which would be suggested by its present division into Books, some of which, as we have suggested, might be expanded into more than one volume. Then we might ask for larger type, instead of as now, 800 words to a page, and also for many more of the author's own clever sketches, and more illustrations such as those he has so judiciously selected from other sources.

NEW TEXT-BOOKS OF GEOMETRY.

Practical Plane and Solid Geometry. By I. H. Morris and J. Husband. Pp. viii+254. (London: Longmans, Green and Co., 1903.)

First Stage Practical Plane and Solid Geometry. By G. F. Burn. Pp. viii + 240. (London: W. B. Clive, University Tutorial Press, Ltd., 1903.) Price 2s.

Examples in Practical Geometry and Mensuration. By J. W. Marshall, M.A., and C. O. Tuckey, M.A. Pp. xii + 70. (London: George Bell and Sons, 1903.)

Elementary Geometry. Section ii. By Frank R. Barrell, M.A., B.Sc. Pp. viii+169 to 284. (London: Longmans, Green and Co., 1903.) Price 1s. 6d.

Theoretical Geometry for Beginners. Part ii. By C. H. Allcock. Pp. viii + 123. (London: Macmillan and Co., Ltd., 1903.) Price 1s. 6d.

Notes on Analytical Geometry. By A. Clement Jones. Pp. iv+172. (Oxford: Clarendon Press, 1903.) Price 6s. net.

Elementary Graphs. By W. M. Baker, M.A., and A. A. Bourne, M.A. Pp. iv+34. (London: George Bell and Sons, 1903.) Price 6d. net.

TEXT-BOOKS in this country which deal with the practical applications of geometry naturally follow the South Kensington division of the Board of Education, a department of the public service which has always taken a leading part in the spread of this branch of knowledge. The department has two distinct syllabuses, one for the guidance of art classes, the other for science. Both syllabuses have quite recently been revised and considerably extended, and are well abreast of the times. Although the two schemes have parts in common, there is an increasing tendency for them